OC and EC analyzed in PM_{10}, $PM_{2.5}$ and PM_1 using thermographic and thermo-optical method at Melpitz site in Germany – a two year comparison

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Since 2003 organic (OC) and elemental carbon (EC), in sum total carbon (TC), were quantified at quartz-fibre filters (HV) with an analyzer, C/S-Max, Seifert Instruments, Germany using a variation of the Guideline VDI2465 (Part 2). This thermographic method (TGVDI) is suitable for quartz filters from high-volume-samplers and also for samples on aluminum foils (melting point≈660°C) using in BERNER-impactors because the maximum temperature doesn't exceed 650°C. Charring processes cannot be accounted here (Spindler et al 2012). A thermo-optical method (TO) using the Lab OC-EC Aerosol Analyzer by Sunset Laboratory Inc. U.S.A. was introduced in 2012 together with temperature protocol EUSAAR2 (Cavalli et. al 2009), transmittance detection and charring correction (TOTEUSAAR2). In European networks, EMEP[1)] and ACTRIS[2)] this method is the preferred technique for quartz fibre filters (final temperature 850°C). The TC detected by TGVDI represents therefore about 84% of TC from TOTEUSAAR2. For a transformation of measurements from the past, avoidance of parallel analysis of quartz-filters with both methods and for a consequent use of charring correction in future, were derived empirical conversion equations for PM at Melpitz site for daily PM measurement in 2012 and 2013 (Equation 1).

$$[OC; EC; TC]_{TGVDI} = m \times [OC; EC; TC]_{TOTEUSAAR2} + n \qquad (1)$$

Because there was no dependence from the particle size but from the season, conversion equations were calculated for twelve months over all sizes in both years. For OC and TC a correlation exists with r^2 of about 0.88 and 0.95, respectively. As EC has a low absolute concentration and a higher spreading in detection (r^2 is about 0.69), it was calculated as EC=TC-OC. Carbonaceous fractions for TOTEUSAAR2 can be estimated now from TGVDI. The results for OC, EC and TC in PM_{10} are 103, 124 and 103% in 2012 and 96, 121 and 82% in 2013, respectively. For impactors estimations cannot be controlled because there are particle sizes smaller than PM_1 and the carrier material is aluminum. A comparison with AMS measurements (OC derived from OM) indicated that OC in PM_1 from TOTEUSAAR2 can represent the best compliance (sites in Germany and Italy) compared to TGVDI or TOREUSAAR2 (detection by reflectance).

Cavalli, F., Viana, M., Yttri, K.E., Genberg, J., Putaud, J.-P. (2010) Toward a standardised thermal-optical protocol for measuring atmospheric organic and elemental carbon: the EUSAAR protocol. *Atmos. Meas. Tech.*, 3. 79-89.

Spindler, G., Gnauk, T., Grüner, A., Iinuma, Y., Müller, K., Scheinhardt, S., Herrmann, H. (2012) Size-segregated characterization of PM_{10} at the EMEP site Melpitz (Germany) using a five stage impactor: a six year study. *J. Atmos. Chem.* 69, 127-157.

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1) Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe

2) Aerosols, Clouds, and Trace gases Research InfraStructure network